

DRAFT MANUSCRIPT
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The Dusky Canada Goose
(Branta canadensis occidentalis)

AN ANNOTATED BIBLIOGRAPHY

Compiled

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DRAFT

ABSTRACT

This bibliography contains 135 references that pertain to the dusky Canada goose (Branta canadensis occidentalis). References are through 1989 and include published material as well as important unpublished agency and administrative reports. They are listed alphabetically by author, annotated when possible, and summarized by subject.

INTRODUCTION

This bibliography is produced as an aid to those working with the dusky Canada goose. It is the result of a search of both the published literature and unpublished agency and administrative reports. Unpublished documents, which are generally available from agencies or authors, are included in this bibliography because they contain much information important to the management of the subspecies. General ornithological texts, check lists, and reference books are not included unless the authors felt that information presented in them is significantly pertinent to the dusky goose. For example, check lists that define seasonal range, migration routes, or pertain to taxonomy of the dusky goose are included while major reference books that present a standard summarization of natural history and range are omitted. Popular magazine accounts of the dusky have not been included.

References were located and verified to determine their authenticity and availability plus annotated, when possible. Annotations were derived from three sources. These are identified in parentheses at the end of the abstract. If an original authors abstract or summary exists and is of suitable length, it was used and identified as the "authors abstract". If a condensed version of the original authors abstract or summary was used, it was identified as "from authors abstract". If a reference was annotated by one of the authors of this bibliography, their initials occur in the parenthesis at the end of the annotation. In some cases reports were not seen and no annotation was available. In these cases "ONS", original not seen, occurs after the citation. A subject index follows the bibliography.

The taxonomic status of the dusky Canada goose has been the subject of considerable discussion and confusion. As a result, a careful examination of the history of taxonomy and usage of both scientific and common names of Canada geese in western North America is necessary before this bibliography can be used.

In 1857, Dr. Suckley collected a Canada goose at Port Townsend, Washington Territory (now Washington State) that Baird (1858) subsequently described as Bernicla leucopareia. However, Baird (1858) noted that the specimen was larger and

darker than leucopareia from the Aleutian Islands. He suggested that if the Port Townsend bird proved to be a different species it could be appropriately called Bernicla occidentalis. Dr. Suckley's specimen is the type specimen for the dusky Canada goose and is in the collection at the U.S. National Museum of Natural History (U.S. Nat. Mus. no. 5994).

In 1884, Baird et al. (1884) considered Bernicla occidentalis a separate species that ranged from Sitka, Alaska, south to California. Unfortunately, they (Baird et al. 1884) used two different common names (The Western Goose and Larger White-cheeked Goose) in reference to B. occidentalis. Based on the type specimen, early descriptions emphasized the presence of a white collar on the neck and a black line on the throat separating the white cheek patches (Baird et al. 1884) as being distinguishing characteristics. Grinnell (1910) and Swarth (1911) pointed out that geese from southeastern Alaska usually did not exhibit these characteristics.

Swarth (1911) concluded that Canada geese were one species (Branta canadensis) with four subspecies (canadensis, occidentalis, hutchinsi, and minima). He further concluded that B. c. occidentalis did not occur in California at any time of the year, that occidentalis is a well-defined subspecies occupying the northwest coast region, and that

the distinguishing characteristics of occidentalis are: extremely dark coloration, smaller size than B. c. canadensis, and a proportionally longer tarsus. Brooks (1914), in response to Swarth's study, reported that Canada geese breeding in coastal British Columbia were as large as canadensis and as dark as occidentalis. Brooks (1914, 1926) proposed that there were three species of Canada geese (canadensis, hutchinsi, minima) and that occidentalis was a subspecies of canadensis. Figgins (1920) criticized Swarth's study and held that occidentalis should not be considered even a subspecies. The discussion continued as Swarth (1920) and Brooks (1926) rebutted Figgins' arguments.

Taverner (1931) listed three species of Canada geese (canadensis, minima, and hutchinsi) and included three subspecies under B. canadensis, (canadensis, occidentalis, and leucopaeria). Taverner (1931) used the common name Western Canada Goose in reference to occidentalis and reported these geese as breeding on the Queen Charlotte Islands, British Columbia and exhibiting little migrational movement. Based on specimens from the Oregon coast and the Willamette Valley, Oregon, Jewett (1932) reported that B. c. occidentalis wanders south to Oregon in the late fall. Moffitt (1937) concurred with Swarth (1911) that most previous reports of occidentalis in California were in error, but reported that occidentalis was a regular winter visitor to the northwestern coast of California. Moffitt

DRAFT

(1937, 1939) maintained the use of the common name White-cheeked goose for occidentalis.

Aldrich (1946) used White-cheeked geese to refer to all Canada geese and called B. c. occidentalis the Pacific Canada Goose. In 1948, Hellmayr and Conover (1948) called occidentalis a subspecies of Branta leucopareia and gave them the common name West Coast Goose.

Delacour (1951) named a new subspecies, Branta canadensis fulva. He included in fulva the large, dark geese that nest from Vancouver Island, British Columbia, north to Glacier Bay, Alaska. Delacour (1951) reported that the breeding range of B. c. occidentalis was around Prince William Sound, Alaska, and perhaps farther north and south. Therefore, he split occidentalis into occidentalis and fulva. In 1953, Dickinson (1953) disputed the validity of fulva and concurred with Hellmayr and Conover (1948) who concluded that variation in size of Canada geese along the Pacific coast formed a cline.

The common name Dusky Canada Goose was apparently first used by Delacour (1954) to refer to B. c. occidentalis.

Delacour's classification is the one that we have followed in our work with Canada geese in Alaska and the Pacific Northwest, but the debate continues. Palmer (1976), Olgilvie (1978), and Owen (1980) prefer to leave both dusky

DRAFT

Canada geese and Vancouver Canada geese (fulva) in the subspecies occidentalis. Lebeda and Ratti (1983) maintained that fulva is a valid subspecies.

Regardless of taxonomic status, there is obviously a discrete population of Canada geese breeding on the Copper River Delta, AK. To insure maximum diversity of the waterfowl resource, this population should be given special consideration when management decisions affecting Pacific Flyway Canada geese are made.

DRAFT

BIBLIOGRAPHY

1. Alaska Dept. of Highways. 1973. Copper River Highway: final Environmental Impact Study. Alaska Dept. of Highways. Juneau. 480pp.

Briefly summarizes the natural history of the dusky goose and identifies potential impacts of highway extension on the population. [BHC]

2. Aldrich, J. W. 1946. Speciation in the white cheeked geese. Wilson Bull. 58:94-103.

Supports splitting Canada geese into 2 species, Branta canadensis and Branta hutchinsii. Proposes 2 new subspecies, B. h. asiatic or Asiatic cackling goose for birds inhabiting the Bering Island and B. c. moffitti or basin Canada goose for birds inhabiting the Great Plains and Great Basin. Agreed with others that B. c. occidentalis included all Canada geese along British Columbia coast, Vancouver Island, and southeast Alaska. [BHC]

3. Bailey, A. M. 1927. Notes on the birds of southeastern Alaska. Auk 44:1-23, 184-205, 351-367.

A large goose designated as B. c. occidentalis is year around resident of Southeastern Alaska. Described observations of geese during 1919. [BHC]

4. Baird, S. F. 1858. Birds. Reports of explorations and surveys for a railroad route from the Mississippi River to the Pacific Ocean. Vol. 9., p. 766.

Contains the original description of the dusky Canada goose from a specimen collected at Port Townsend, Washington Territory in 1857. Although Baird placed the specimen under Bernicla leucopareia he noted "that the possibilities are very great that the present species is really distinct from leucopareia". He suggested that if the bird from Port Townsend was a different species it would be appropriate to call it Bernicla occidentalis. The type specimen is in the collection of the U. S. National Museum of Natural History in Washington, D. C. [JEC]

5. _____, S.F., T. M. Brewer, and R. Rideway. 1884. The waterbirds of North America. Vol. 1., Memoirs Mus. Comp. Zool., Harvard Coll., 12:1-537.

Provides information about the type specimen of B. c. occidentalis and three additional specimens. The type was collected by Dr. Suckley in 1857 at Port Townsend,

DRAFT

Washington, Territory. Another specimen was collected by Dr. Kennerly on Puget Sound, a second came from Sitka, Alaska, collected by F. Bischoff in May, 1866, and a third from San Francisco, California, by F. Gruber in April of 1861. [JEC]

6. Bartonek, J. C., J. G. King, and H. K. Nelson. 1971. Problems confronting migratory birds in Alaska. Trans. North Amer. Wildl. and Nat. Resour. Conf. 36:345-361.

Identifies petroleum development, proposed river basis projects, and coal field development as potential problems confronting the dusky goose. [BHC]

7. Bromley, R. G. H. 1976. Nesting and habitat studies of the dusky Canada goose (Branta canadensis occidentalis) on the Copper River Delta, Alaska. M.S. Thesis. Univ. Alaska, Fairbanks. 81pp.

Nesting and habitat studies of dusky Canada geese were conducted in 1974 and 1975. The Copper River Delta experienced uplift of 1.89 m in the 1964 earthquake causing altered rates of plant succession.

Reproductive success was high in 1974 and low in 1975, partly as a result of (1) spring weather conditions, (2) age of nesting adults in relationship to clutch size, and (3) nest predation. Habitat studies

DRAFT

indicated that a substantial increase in the nesting use of sedge was due to (1) an increase in the availability of sedge as a viable cover type, and (2) the increased nesting density of geese may have created social pressures resulting in the use of less favorable habitat. It was concluded that the population was not under immediate threat as a result of the earthquake. Implications of present and future trends in plant succession were discussed. [Authors' abstract]

8. _____ . 1985. The energetics of migration and reproduction of dusky Canada geese (Branta canadensis occidentalis). Ph.D. Dissert. Oregon State Univ., Corvallis. 116pp.

Adult female dusky Canada geese were studied on the Copper River Delta, Alaska and in the Willamette Valley, Oregon during April through July, 1977 to 1979. Tissue composition analysis was performed on 162 geese to determine the chronology of use of protein and energy reserves in relation to migration, prelaying, egg laying and incubation periods, and the role of food items in meeting energy requirements during these four periods.

Endogenous lipids were heavily utilized during migration, egg laying and incubation. Endogenous

DRAFT

protein was important during egg laying and incubation. Food supplied about half of the energy requirements calculated for the migration period, all needs during prelaying, over 75% during egg laying and about one third of energy requirements during incubation. Food was most important for supplementing high protein needs of laying geese and both protein and energy needs of geese during the last third of the incubation period when endogenous reserves were depleted.

Although northern nesting geese have been assumed to be largely independent of food during prelaying through incubation, it was suggested that food is in fact proximately important, influencing both clutch size and patterns of energy use during incubation.

Ultimately, the timing of nesting and clutch size of northern nesting geese may have evolved in response to the need for an optimal food supply about two-thirds of the way through incubation. [Author's abstract]

9. Brooks, A. 1914. The races of Branta canadensis Condor 16:123-124.

Criticizes the breeding range of B. c. occidentalis as presented in the latest A. O. U. check-list as being impossible. He comments, mostly favorably, on Swarth's

(1913) study of Canada geese from the San Joaquin Valley, California. [JEC]

10. _____. 1917. Birds of the Chilliwach District, B. C. Auk 34:28-50.

Refers to the dark "honkers" that are common in the Chilliwach Valley, B. C. during winter and early spring as the "breeding bird of the coast strip to the northward". [BHC]

11. _____. 1923. Notes on the birds of Porcher Island, B. C. Auk 40:217-224.

Reports Canada geese of the subspecies B. c. occidentalis residing on Porcher Island, B. C. [BHC]

12. _____. 1926. Notes on the geese of the Branta canadensis group. Ibis, Ser. 12:339-346.

Supports Swarth's (1913) contention that occidentalis is a subspecies of Branta canadensis, but contrary to Swarth (1913) contended that hutchinsi and minima were species of Branta rather than subspecies B. canadensis. [JEC]

DRAFT

13. Campbell, B. H. 1984. Status of the dusky Canada goose on the Copper River Delta. Proceedings of the Tenth Copper River Delta Conference. U.S. Forest Service. Cordova, Alaska. pp. 33-37.

Summary of changes on the nesting grounds between 1974-75 and 1982. Shrub cover had increased dramatically by 1982 and more nests were found in meadows and tall shrub habitats. Nest densities had declined up to 60% and nest success was 48% in 1982 as compared to an average 76% in the 1970s. Predation was the major cause of nest failure.

Recommendations for management on wintering grounds were: cutting 3 weeks of the end season; vary open and closed hunting areas by subspecies distribution; restrict bag to one "heavy" goose; hunter education to assist hunters in distinguishing between dusky and other subspecies of Canada geese. [BHC]

14. _____. 1984. Annual Report of survey-inventory activities, Part V. Waterfowl. Vol. XIV. Alaska Dept. Fish and Game. Fed. Aid Wildl. Rest Prog. Rep. Proj. W-22-2, Job 11.0. Juneau. 29pp.

Summary of information collected on the nesting grounds in 1983. Nest success was 52% and mean clutch size was

5.5 eggs. Predation was the primary cause of nest failure with about two-thirds of the nest destruction attributed to mammalian predators. The portion of the July molting population composed of young birds was estimated at 15-18% and a Fall Flight of 19,300 geese was predicted. [BHC]

15. _____ . 1988. Habitat availability, utilization, and nesting success of dusky Canada geese on the Copper River Delta, Alaska. Alaska Dept. Fish and Game Rep. Anchorage. 45pp.

Habitat availability, use by nesting geese, and nesting fate were sampled between 1982-86 to determine how succession has affected the nesting ecology of the dusky goose. Shrub communities have displaced much of the mixed grass/forb habitat that was preferred by geese for nesting in 1974. Geese have apparently adjusted to this change and are using the shrub habitats in a greater proportion than expected based on the availability. The distribution of nests in shrub and open levee habitats is related to spring phenology with more nests occurring in shrub habitats in early springs. Nest success has declined since the late 1970's with predation by brown bears, canids, and predaceous sea birds being the primary cause of nest losses. Nest predation rates are related to spring

DRAFT

phenology with greater losses occurring during late springs. However, the magnitude of nest predation by the 3 major predators varied annually independent of spring phenology. Brown bears were consistently responsible for about half the nest destruction while canids and predaceous seabirds were responsible for an average 20% and 16%, respectively. No association between habitat type and overall level of nest destruction or nest destruction by specific predator was observed. While canids and avian predators may have preferences for certain habitats for foraging, the dominance of the opportunistic brown bear, which appears to have no preference, as a nest predator probably masks these preferences. Because secondary succession appears to be toward tall shrub/forest communities favored by mammalian predators, poor nest success is likely to continue unless predators are managed to benefit the dusky goose. [Authors' abstract]

16. _____, and D. E. Timm. 1983. Annual report of survey-inventory activities. Part V. Waterfowl. Alaska Dept. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-22-1, Job 11.0 Juneau. 45pp.

Summary of information collected on the nesting grounds in 1981 and 1982. Nest success was not measured in 1981 but was 49.3% in 1982. Clutches averaged 4.9 eggs

DRAFT

in 1981 and 4.8 eggs in 1982. Nest predation was the primary cause of nest failure. Production was 17.9% young in 1981 and 23.7% in 1982. [BHC]

17. _____, and T. C. Rothe. 1985. Annual report of survey-inventory activities. Part XIII. Waterfowl. Alaska Dept. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-22-3, Job 11.0. Juneau. 31pp.

Summary of information collected on the nesting grounds in 1984. Nest success was 75.8% and average clutch size was 5.6 eggs. Most nest losses were to mammalian predators. Production was 20%. A total of 496 geese were collared in support of research on the wintering grounds. A 3-year study of brown bears as predators on goose nests was initiated. [BHC]

18. _____, and T. C. Rothe. 1986. Annual report of survey-inventory activities. Part XVI. Waterfowl. Alaska Dept. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-22-4, Job 11.0. Juneau. 36pp.

Summary of information collected on the nesting grounds in 1985. Nest success was 8.9% and average clutch size was 4.4 eggs. Nest predation, primarily by large mammalian predators, was cause of low nest success.

DRAFT

Production was 3.7% young. A total of 1958 geese were collared.

First year results of the brown bear study indicated that primarily immature bears and females with offspring were active on the nesting grounds. Most of the bears moved inland onto salmon spawning streams in July. [BHC]

19. _____, T. C. Rothe, and D. H. Rosenberg. 1987. Annual report of survey-inventory activities. Part XIII. Waterfowl. Alaska Dept. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-22-5, Job 11.0. Juneau. 55pp.

Summary of information collected on the nesting grounds in 1986. Nest success was 11.4% and mean clutch size was 4.9 eggs. Nest predation, primarily by large mammalian predators, was the cause of most of the nest losses. Production was 10.7%. A total of 477 geese were collared.

Results of the second year of the brown bear study further indicated that primarily immature bears and females with offspring were active on the nesting grounds. Bears moved inland onto salmon spawning streams in July and began entering winter dens in

DRAFT

November and December. They emerged from dens in late April and moved onto the nesting grounds in mid-May.

[BHC]

20. _____, and H. J. Griese. 1987. Management options for dusky Canada geese and their predators on the Copper River Delta, Alaska. Alaska Dept. Fish and Game. Anchorage. 91pp

Discusses ecology of the dusky goose and identifies and recommends several management options for the goose, nesting grounds habitat, and predators that would increase goose production. [BHC]

21. _____, T. C. Rothe, and D. H. Rosenberg. 1988. Annual report of survey-inventory activities. Part XIII. Waterfowl. Alaska Dept. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-22-6, Job 11.0 Juneau. 75pp.

Summary of information collected on the nesting grounds in 1987. Nest success was 23.7% and average clutch size was 5.4 eggs. Nest predation was primary cause of nest losses. Production was 9.5% young. A total of 544 geese were collared. One hundred and six geese were transplanted to Middleton Island in the Gulf of Alaska in an attempt to establish a breeding population.

Results of an experimental reduction in brown bear numbers on the nesting grounds indicated that nest predation is compensatory. In the absence of brown bears, coyote and avian predation increased and nest success remained poor. [BHC]

22. _____, and T. C. Rothe. 1989. Annual report of survey-inventory activities. Part XIII. Waterfowl. Alaska Dept. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-23-1, Study 11.0. Juneau. 42pp.

Summary of information collected on the nesting grounds in 1988. Nest success was 17.3% and average clutch size was 5.5 eggs. Predation was the primary cause of nest failure. Production was estimated at 22.5%. A total of 801 geese were banded and 506 were also collared. Eighty seven geese were transplanted to Middleton Island.

23. Chapman, J. A. 1967. Population characteristics, hunter kill, and productivity of dusky Canada geese. M.S. Thesis, Oregon State Univ., Corvallis. 82pp.

Between 1964-67 sex and age data were collected from approximately 5,000 geese in the Willamette Valley, Oregon. More than 95 % of the geese examined were

DRAFT

dusky Canada geese. A large portion of this subspecies wintering in Oregon do so on the Oak Knoll Complex, a group of hunt clubs located about 7 miles east of Corvallis, Oregon. Large numbers of these geese left the "complex" earlier in each succeeding year of the study and moved to the William L. Finley National Wildlife Refuge which was established in 1964. Hunters at the Oak Knoll Hunt Club killed an average of more than two geese per day, while the remainder of the Willamette Valley hunters killed an average of less than one goose per year. Of the 4,000 to 5,000 dusky Canada geese killed annually in the Willamette Valley, between 50 and 67 % were taken on the Oak Knoll Complex. Immatures made up a disproportionately high percentage of the kill on the "complex" in all three years of the study. In the remainder of the Willamette Valley, immatures and adults were killed in nearly equal numbers. The peak of the kill of immatures occurred early in the hunting season and the peak of the adult kill occurred in the late hunting on the Oak Knoll Complex. There appeared to be little correlation between numbers of geese present and goose kill on the "complex," however, in the remainder of the study area the reverse appeared to be true. More adult males than females were killed in all three years of the study. In 1964 and 1965 fewer subadult males than females were killed, but in 1966 subadult males and females were

killed in nearly equal numbers. Immature males and females were killed in nearly equal numbers except in 1965 when more males than females were killed. The Oregon pre-season population was between 18,000 and 23,000 geese. The sex and age composition of the Oregon pre-season population was calculated using a relative recovery rate and data collected on the Oak Knoll Complex. The percentage of immatures in the population increased in each year of the study. The percentage of adults in the population was stable in 1964 and 1965, but in 1966 a decline in their number was noted. The percentage of subadults in the population in 1965 and 1966 was lower than in 1964. The population was composed of nearly 50 % immatures in 1966 indicating that the population may be undergoing excessive mortality. Productivity was low in 1964, but near its maximum 1965 and 1966. A theoretical maximum and minimum productivity were applied to the 1966 pre-season population and it was found that the population may decrease even though the population is maintaining the theoretical maximum productivity. The possible methods of reducing the mortality of dusky Canada geese are discussed. [From authors' abstract]

24. _____, 1970. Weights and measurements of dusky Canada geese wintering in Oregon. Murrelet 51:34-37.

DRAFT

Weights and measurements of 1,034 Canada geese wintering in the Willamette Valley of Oregon during the 1965-66 and 1966-67 waterfowl season indicated that all sex and age classes gained significant weight through early January. Weights of adult and immature males increased from $3,490 \pm 274$ gms and $3,134 \pm 278$ gms, respectively, in November to $3,882 \pm 293$ gms and $3,564 \pm 387$ gms, respectively, in January. Adult and immature female weights increased from $2,948 \pm 189$ and $2,700 \pm 235$ gms, respectively, to $3,251 \pm 210$ and $3,038 \pm 319$ gms, respectively, during the same period. Exposed culmen length was 45.91 ± 2.24 mm and 44.60 ± 2.24 mm for immature males and females, respectively, and 45.53 ± 2.74 mm and 44.42 ± 2.09 mm for adult males and females, respectively. Flattened wing length was 452.33 ± 12.84 mm and 440.40 ± 12.87 mm for immature males and females, respectively, and 478.73 ± 12.57 mm and 450.22 ± 15.11 mm for adult males and females, respectively. Tarsus length averaged 91.21 ± 4.22 mm and 86.30 ± 4.34 mm for immature males and females, respectively and 93.32 ± 6.14 mm and 85.91 ± 4.13 mm for adult males and females, respectively. Middle toe and claw lengths averaged 86.22 ± 4.0 mm and 81.44 ± 3.24 mm for immature males and females, respectively, and 87.96 ± 3.79 mm and 83.09 ± 3.39 mm for adult males and females. Tail lengths were 129.72 ± 7.49 mm and 123.40 ± 6.57 mm for immature males and females,

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respectively, while adult males and females had an average tail length of 143.53 ± 6.51 mm and 137.35 ± 6.79 mm, respectively. [BHC]

25. _____, C. J. Henny, and H. M. Wight. 1969. The status, population dynamics and harvest of the dusky Canada goose. Wildl. Monogr. 18:1-48.

Approximately two-thirds of the annual dusky goose harvest occurred on the wintering grounds in Oregon between 1952-65. Immature geese were more than twice as vulnerable to hunting as adults and were considerably more vulnerable early in the season. Immature geese had an average first-year mortality rate of 57% between 1952-65 while the adult mortality rate ranged between 33% and 35%. An estimated 50-66% of the 2-year old females must nest to maintain a stable population at this mortality rate. Concluded that the dusky population should be managed for a fall flight of 34,750-50,000 birds. [BHC]

26. Clark, S. L. 1976. Effects of winter grazing by geese on ryegrass seed yield. M.S. Thesis, Oregon State Univ. Corvallis. 18pp.

The effects of grazing by Canada geese (Branta canadensis) on ryegrass (Lolium spp.) seed yield was

DRAFT

studied from October 1974 to July 1975 in the Willamette Valley, Oregon. Exclosures were used to compare grazed and ungrazed plots, and an index to grazing intensity was obtained from the numbers of geese on each study field. Grazing by geese significantly increased yield in two study fields; there were no significant effects on yield in the remaining eight fields grazed by geese. [Authors' abstract]

27. _____, and R. L. Jarvis. 1978. Effects of winter grazing by geese on yield of ryegrass seed. Wildl. Soc. Bull. 6:84-87.

See No. 25 abstract.

28. Cline, D. and C. Lenhart. 1985. The dusky Canada goose. Pages 433-436 in R. L. Di Silvestro, ed. Audubon Wildlife Report 1985. National Audubon Society. New York.

Presents description of the dusky goose, its significance, history, current population trend, management, and prognosis. Recommends closure of the goose season in portions of western Oregon, southwestern Washington, and the Copper River Delta plus ban on collecting eggs or goslings. [BHC]

29. Cooke, W. W. 1906. Distribution and migration of North American ducks, geese, and swans. U. S. Biological Survey Bull 26:1-90.

Early account of the subspecies B. c. occidentalis states that this form is confined to the Pacific slope and breeds from the Klamath Lakes and Lake Tahoe, north to Sitka and Mitkof Island. It winters from Washington south to San Diego County, CA. It appears south of its breeding range in early November and starts north so early in the spring that after the middle of March few are left in the southern part of the winter range.

[Authors statement]

30. Cornely, J. E. and R. L. Jarvis. 1984. Status of Canada geese wintering in western Oregon and southwestern Washington. Rep. to Dusky Canada Goose Subcommittee. Pac. Flyway Study Committee. 7pp.

Reports the dusky Canada goose population at the lowest level in many years. The total number of Canada geese in the winter survey area peaked at about 69,000.

Subspecies composition derived from aerial photography was about 59,000 Taverner's Canada geese (B. c. taverneri) and about 10,000 dusky. The dusky population declined 40.6% and the Taverner's

population increased by 30.9% compared to 1983. Even though duskys comprised only about 15% of the population they made up 44% of Canada geese checked through hunter check stations on federal and state hunting areas. The percent juvenile geese in the harvest was 39% for duskys and 70% percent for Taverner's. For the second year in a row there appeared to be a movement of Canada geese from the south and mid-Willamette Valley north to the Columbia River following the hunting season. [JEC]

31. _____, and R. L. Jarvis. 1985. Status of Canada geese wintering in western Oregon and southwestern Washington. Rep. to Dusky Canada Goose Subcommittee. Pac. Flyway Study Committee. 6pp.

During the 1984 nesting season, nesting success for dusky Canada geese was 75.8 %, the highest since 1977. In spite of the excellent nesting success, recruitment was estimated to be only 18.3 % young in the population, indicating poor gosling survival. Age ratios of geese examined at check stations substantiated the low recruitment rate. The total number of geese wintering in the area during 1984-1985 peaked at about 65,000 birds. that was a decrease of 5.7 % from the previous year and the first decrease in total geese in ten years.

DRAFT

Because of the low dusky population and poor recruitment, the Canada goose bag limit was reduced to one, and the season was shortened. Goose identification workshops were developed and a publicity campaign mounted. Despite these measures the dusky harvest was unacceptably high and an emergency goose hunting closure was invoked by Washington and Oregon on the 6th of December. Dusky were only 11.5 % of the wintering geese, but made up 46 % of the harvest. The 1985 mid-wintering estimate for the dusky population was 7,500 geese. As many as 3,000 cackling Canada geese wintered in western Oregon in 1984-1985. Because the hunting season was closed for cacklers, their presence further complicated already complex goose management problems. [JEC]

32. _____, R. L. Jarvis, and M. R. Hills. 1986. Status of Canada geese wintering in western Oregon and southwestern Washington. Rep. to Dusky Canada Goose Subcommittee. Pac. Flyway Study Committee. 5pp.

Recruitment surveys on the Copper River Delta indicated a very poor production year. During the subsequent winter the number of Canada geese in the survey area peaked at about 72,500 birds. About 500 of them were Great Basin Canada geese (*B. c. minima*), 52,250 were

DRAFT

Taverner's Canada geese, and 12,190 were dusky Canada geese. Severe harvest restrictions resulted in fewer dusky beings harvested, but age ratios in harvested dusky were indicative of continued poor production.

Observations of marked geese suggest dusky are much more sedentary than Taverner's or cackling geese.

Numbers of cackling geese wintering in western Washington and Oregon have increased markedly in recent years. [JEC]

33. _____, B. H. Campbell, and R. L. Jarvis. 1985. Productivity, mortality, and population status of dusky Canada geese. Trans. North Amer. Wildl. and Nat. Resour. Conf. 50:540-548.

Review of the history of the dusky goose and summary of recent (1979-84) population changes and management.

Average nest success had dropped from about 82% between 1959-74 to 48% between 1979-84. Nesting habitat on the Copper River Delta has changed since the area was uplifted in 1964 with brush becoming much more predominate. Consequently, mammalian predators and nest predation have increased.

Management of the dusky goose on the winter grounds has become more complicated due to a greatly enlarged

DRAFT

wintering population of Canada geese of which a shrinking proportion is comprised of dusky geese. The number of Canada geese wintering in the Willamette Valley of Oregon has increased from 20,000-30,000 during the 1960s and early 1970s to over 70,000 in 1984. The portion of that population comprised of dusky geese has declined to less than 20%.

The primary source of mortality for the dusky goose is hunting on the wintering grounds. Mortality exceeded recruitment between 1979-84 and the percentage of adults in the harvest between 1985-83 has averaged 56% compared to 22-39% in 1964-66. In response to the decline in dusky goose numbers and heavy harvest, goose hunting seasons and bag limits were reduced in 1983.

Management and research priorities in 1985 where intensification and refinement of methods used to monitor production on the Copper River Delta, development of a more reliable method of censusing dusky geese, quantifying nesting habitat availability and use, experiment with habitat enhancement on the nesting grounds to reduce nest predation, establishing additional breeding populations in suitable habitat in areas other than the Copper River Delta and more accurate methods of assessing goose harvest. [BHC]

34. _____, M. B. Naughton, M. R. Hills, and K. M. Raftery. 1988. Distribution of wintering dusky and cackling Canada geese in western Oregon and western Washington, 1985-1988. U. S. Fish and Wild. Serv. Rep. Portland. 77pp.

The report summarizes the distribution of dusky and cackling Canada geese in Washington and Oregon based on observations of marked birds made during the winters of 1985-1986 through 1987-1988. Over 34,400 collar observations were recorded. A total of 2,883 different dusky collars were observed 31,052 times and 678 different cackler collars were read 2,984 times. The report presents numerous maps illustrating the results of these observations. The patterns of distribution based on this project were not much different than anticipated. Dusky Canada geese were observed regularly from Willipa NWR near the mouth of the Columbia River throughout the lower Columbia River to Sauvie Island and vicinity. Core areas were Willipa NWR, Lewis and Clark NWR, Columbia White-tailed Deer NWR, Deer Island, Woodland Bottoms, Sauvie Island, and Ridgefield NWR. A few sightings were made between Puget Island and Longview, Washington, near Vader, Washington, Tualitin Valley, Oregon, south of Hillsboro and Forest Grove to Wapato Lake near Gaston.

DRAFT

The next major core area extends from southwest of McMinnville down through the Yamhill River Valley and Baskett Slough NWR to Dallas and Rickreall. The next core area is Salem and vicinity, including Brown-Minto Island and Oregon Correctional Institute Farm. South of Salem is a core area centered on Ankeny NWR.

The next important area is the site of the former Oak Knoll complex east of Corvallis. The next core area centers on W. L. Finley NWR. The final dusky core area is Fern Ridge Reservoir near Eugene. The distribution of cacklers largely coincided with that of the dusks and tended to be in the center of the dusky core areas. A small number of Canada geese marked on the Copper River Delta appear to winter each year in the following locations: western Prince William Sound at the Cannery Creek not far from Whittier, Alaska; near Craig on Prince of Wales Island in southeastern Alaska; Queen Charlotte Islands, British Columbia; and Vancouver Island, British Columbia. [JEC]

35. Crow, J. H. Circa 1966. Some effects of the March 27, 1964 earthquake on the ecology of the Copper River Delta, AK. Alaska Dept. Fish and Game Rep. Fairbanks. 18pp.

Summarizes some of the ecological work done on the Copper River Delta relating to the nesting habitat of dusky geese during 1965 and 1966. Defines immediate post-earthquake composition of the mixed grass/forb community on levees used extensively by nesting geese. Species characteristic of the forb-grass community are migrating laterally, both down slough banks and into pond basins, since the earthquake. Predicts that an increase in area available for nesting will be transient and an ultimate decrease in nesting habitat will occur. [BHC]

36. _____ . 1968. Plant ecology of the Copper River Delta, Alaska. Ph.D. Dissert. Washington State Univ. Pullman. 120pp.

A study on the Copper River Delta, Alaska, was undertaken soon after the Good Friday earthquake, March 27, 1964. The earthquake resulted in a 1.89 m uplift of the delta with respect to sea level.

Four major belts of vegetation were described. These belts were characterized by: the Hedysarum-Deschampsia Community; the Myrica Poa Community; the Salix Festuca Community; and the Alnus and Picea dominated communities, the last two found in the highest

vegetation belt. Communities associated with the Hedysarum Deschampsia belt were also described.

Prior to the earthquake storm tides occasionally inundated the entire Hedysarum-Deschampsia belt. The other belts were affected very little, if at all, by such tides. Under post earthquake conditions, the storm tides remain below the level of Hedysarum-Deschampsia and other extant communities.

Desalinization and associated pH depression of habitats are documented.

Emphasis was placed on the Hedysarum-Deschampsia belt because of its important to the Dusky Canada Goose (Branta canadensis occidentalis) as a nesting area. Prior to the earthquake nearly all goose nests were restricted to the crests of channel banks where the Hedysarum-Deschampsia Community was dominant.

Permanent plots provided evidence of the degradation of the Hedysarum-Deschampsia and other communities within this belt, along with the invasion and establishment of species characteristic of belts farther from the sea. Shrub invasion is occurring most readily along channel banks adjacent to the Hedysarum-Deschampsia vegetation.

Evidence gathered from nearby tidal flats strongly suggested that their potential for Hedysarum-

Deschampsia or better drained communities is rather limited. [Authors' abstract]

37. _____, 1972. Earthquake-initiated changes in the nesting habitat of dusky Canada goose. Pages 130-136 in The great Alaska earthquake of 1964: biology. Natl. Acad. Sci. Publ. 1609.

The dusky Canada goose nests in a remarkably restricted area, a part of the Copper River Delta occupied by a plant community characterized by Hedysarum alpinum americanum and Deschampsia beringensis. This vegetation flourishes in the slightly saline soils at the tops of channel banks, where before the earthquake it was inundated by diluted seawater during occasional storm tides. As a result of uplift during the earthquake, however, the pre-earthquake channel-bank vegetation and the interchannel areas are no longer reached even by the highest tides, and the soil is being rapidly desalinized. Drier conditions and the removal of salt permit invasion of the Hedysarum-Deschampsia belt by plants characteristic of other belts, and hence the favored nesting habitat of the goose is deteriorating. Presumably the Hedysarum-Deschampsia community will eventually reestablish itself at a lower level on the tidal flats, but the area available is expected to be much smaller than the

area occupied at present. Over the years the dusky Canada goose will find progressively more restricted nesting grounds, which will lead to a reduction in its numbers unless it can adapt to other kinds of vegetation. [Authors' abstract]

38. Cumming, R. A. 1932. Birds of the Vancouver district, British Columbia. Murrelet 13:4-5.

Lists the dusky Canada goose as a winter migrant in the Vancouver, B. C. area. [BHC]

39. Dawson, W. L. 1897. Nesting of the larger White-checked goose (Branta Canadensis occidentalis) in Okanogan Co., Wash. Auk 14:87-88.

Report of the subspecies B. c. occidentalis nesting on the Columbia River in eastern Washington. [BHC]

40. _____. 1909. The birds of Washington. Occidental Pub. Co. Seattle. 997pp.

[ONS]

41. Delacour, J. 1951. Preliminary note on the taxonomy of Canada Geese, Branta canadensis Amer. Mus. Novit. 1537:1-10.

Recognized 12 subspecies of Canada geese, considered the dusky Canada goose a separate subspecies from the Vancouver Canada goose. [BHC]

42. _____. 1954. The Waterfowl of the World. Vol. 1. Country Life Limited. London. 281pp.

Cited in discussion of Dusky goose taxonomy.

Recognized the dusky goose (B. c. occidentalis) and Vancouver goose (B. c. fulva) as separate subspecies of Canada geese and was apparently first author to use dusky Canada goose as common name for B. c.

occidentalis. Listed range of dusky from Copper River Delta to eastern Alaska Peninsula including Cook Inlet.

[BHC]

43. Dickinson, J. C. Jr. 1953. Report on the McCabe collection of British Columbia birds. Bull. Mus. Comp. Zool., Harvard Coll. 109:123-209.

Based on the examination of 14 specimens from coastal British Columbia, the author questions the validity of Branta canadensis fulva as a race separate from B. c. occidentalis [JEC]

DRAFT

44. Dixon, J. 1908. Field notes form Alaska. Condor
10:139-143.

Reports that goslings were "everywhere" in the canoe
pass area of Hinchinbrook Island, Prince William Sound
in 1908. [BHC]

45. Dunn, E. H., and C. D. MacInnes. 1987. Geographic
variation in clutch size and body size of Canada geese.
J. Field Ornithol. 58:355-371.

Included information from dusky Canada geese as part of
their analysis. Female body size and clutch size
decreased with latitude. Weather variables accounted
for as much variation in clutch and body size as did
latitude, longitude, and altitude. Body size decreased
with increasing latitude to greater extent than clutch
size. [JEC]

46. Figgins, J.D. 1922. _____ . Proc.
Colo. Mus. Nat. Hist. 3:1-18.

[ONS]

47. Gabrielson, I. N., and F. C. Lincoln. 1959. Birds of
Alaska. The Stackpole Co., Harrisburg, PA, 922pp.

Brief description of B. c. occidentalis and its range. Reports that Gabrielson saw numerous geese including pairs on the Copper River Flats on 10 June 1940. He also found a nest containing 8 eggs. In the same area on September 27, 1941, he saw about twenty geese and reported that large flocks have been seen in the spring in Yakutat Bay. [JEC]

48. Giezentanner, K. 1987. 1986 progress report on the use of artificial nesting islands by dusky Canada geese, Copper River Delta, Alaska. U. S. Forest Service Rep. Cordova, AK. 10pp.

Eight percent (10) of 121 artificial nest structures were used by dusky geese. Seven of the 10 nests were on sandbag islands while 1 was on a fiberglass floating island and 2 on barrel islands. Of these 3 (43%) of the sand bag island nests were successful followed by 1 barrel and no floater island nests being successful. Brown bears and avian predators appeared to be major predators on island nests. Factors that may have influenced nesting success on artificial islands are discussed. [BHC]

49. _____, T. Levkovitz, and D. Chester. 1989. Dusky Canada goose monitoring report 1989, Copper River Delta Alaska. U. S. Forest Service Rep. Cordova, AK. 16pp.

DRAFT

Two hundred and twenty-six (43%) of 620 artificial islands installed on the Copper River Delta to provide safe, dry nesting sites for geese were sampled in 1989 to ascertain their use. Of the 266, 193 (73%) were usable, i.e. not flooded or damaged. Thirty nesting attempts (16% of the islands sampled) were documented. Seventeen of these were successful, 6 destroyed by predators, 3 abandoned, and 4 with unknown fate. Of the nests destroyed, 66% were by bears, 17% by avian predators, and 17% by unknown predators. Nests were attempted on 30% of the available fiberglass floating islands, 8% of the available sandbag islands, 75% of the available barrel islands, and 17% of the available innertubes. No attempts on platform or dish islands were recorded. Based on the ratio of available islands to those used, fiberglass floats were the preferred island for nesting. Sandbag and fiberglass floating islands required the least amount of yearly maintenance. [BHC]

50. Grinnell, J. 1910. Birds of the 1908 Alexander Alaska expedition. Univ. California Publ. Zool. 5:361-428.

Reported a few geese at the head of Cordova Bay, at Graveyard Point on Montague Island, and at Chenaga Island. Small flocks were noted at Hinchinbrook Island

DRAFT

and many pairs and some small flocks were seen on Hawkins Island. Grinnell reported that Joseph Dixon found a nest with six eggs on June 18, 1908, near Canoe Passage on Hawkins Island. The nest was at the head of a tidal slough at the edge of the forest near the base of a hemlock tree. The nest was lined with moss and down and would have hatched in two or three days.

[JEC]

51. Guiguet, C. J. 1958. The birds of British Columbia (6) Waterfowl. British Columbia Prov. Mus. Handbook 15:1-84.

Reported the range of the western Canada goose (*B. c. occidentalis*) as along the Pacific coast from Alaska to Washington. In the winter a few birds "straggle down the Washington and Oregon coasts, but this bird is largely resident along the British Columbia coast and islands." Suggested that birds were largely nonmigratory. [BHC]

52. Gullion, C. W. 1951. Birds of the Southern Willamette Valley, Oregon. Condor 53:129-149.

Reported at least two races of Canada geese wintering at Fern Ridge Reservoir in the late 1940's. From mid-October through later March about 500 light-breasted

birds were present. In late November large dark-breasted geese moved into the area and by mid-January totaled 1,000. [JEC]

53. Hansen, H. A. 1960. Annual waterfowl report, Alaska-1960. U. S. Bureau of Sport Fisheries and Wildl. Rep. of unknown origin. 28pp.

Between 1953-58 2,989 geese were banded on the Copper River Delta with 851 (28.4%) recoveries. The distribution of recoveries was: Copper River Delta - 57 (6.7%), Southeast Alaska - 4 (0.4%), Vancouver Island, B.C. - 92 (10.8%), south interior of British Columbia - 1 (0.1%), Puget Sound - 12 (1.4%), mouth of Columbia River - 101 (11.9%), Willamette Valley - 542 (63.4%), N. W. coast of California - 3 (0.3%), unknown - 6 (0.6%). Based on band recovery dates, geese apparently left the CRD no later than Oct. 15 and had passed the S. E. Alaska coast by Oct. 20. Early band recoveries on Vancouver Island and in the Puget Sound area are about Oct. 20 with the greatest number of recoveries occurring in early Nov. Earliest arrivals in the Willamette Valley are during the first part of Nov. with uniformly heavy return of bands from about Nov. 10 - end of the hunting season. [BHC]

54. Hansen, H. A. 1961. Loss of waterfowl production to tide floods. J. Wildl. Manage. 25:242-248.

Describes mechanics of tidal flooding and assessment of nest mortality due to flooding on the Copper River Delta. Annual tidal rhythms and heights are such that all nests are exposed to at least one high cycle of tides. Most geese nests (97%) are built on high ground which comprises no more than 10-15% of the Delta. Geese built nests up to escape encroaching tides. Of 89 nests sampled, 53% had been flooded at least once. Of 222 nests, 87.4% hatched at least 1 egg with flooding being the primary cause of nest failure. Losses from flooding were due to lowered hatchability of eggs rather than total destruction of nests. [BHC]

55. _____. 1962. Canada geese of coastal Alaska. Trans. North Amer. Wildl. and Nat. Resour. Conf. 27:301-329.

Band recoveries demonstrated that dusky Canada geese and Vancouver Canada geese are different populations. Describes breeding range for dusky geese to extend along coast of Alaska from Bering Glacier to Cook Inlet with the greatest concentration on the Copper River Delta. Dusky start migrating from the nesting grounds in late September with the first major stopping area

being Queen Charlotte and Vancouver Islands. From there, they move to the lower Columbia River and the Willamette Valley of Oregon. A few flocks totaling an estimated 1,000-1,500 geese winter in Prince William Sound, Alaska.

The fall dusky population was estimated to have ranged in size from 10,000-20,000 between 1952-62. First year mortality rate for juvenile dusky between 1951-60 was nearly 57% while mortality rates after the first year averaged about 35% annually. Age structure of the harvest on the wintering grounds changed during the hunting season with 91% of the juvenile kill occurring prior to December 27. Conversely, 52% of the adult harvest occurred between Dec. 27-Jan. 14. Limiting wintering habitat and harvest were probably the greatest limiting factors for the dusky through 1961.

[BHC]

56. _____. 1968. Pacific Flyway Canada goose management-federal and state cooperation. Pages 43-49 in R. L. Hine and C. Schoenfeld, eds. Canada goose management; Current continental problems and programs. Dembar Ed. Research Services, Madison, WS.

Seven subspecies of Canada geese winter in the Pacific Flyway. Most of them come from Alaska. Most of them

DRAFT

are physically and numerically smaller than their eastern cousins. Three subspecies require special management measures at the present time.

The Aleutian Canada goose is on the official list of rare and endangered species. Introduced foxes are the culprit. Through aerial application of treated bait we may be able to rehabilitate enough nesting islands to save the race. The Great Basin population of the western Canada goose has been under such heavy hunting pressure that curtailed seasons and bag limits have been in effect since 1955. These self-imposed restrictions have resulted in significant increases in the various flocks. The dusky Canada goose is a small, well-defined subspecies whose population dynamics is well understood but whose destiny hinges on the practices of a few hunting clubs within a 20-mile radius of Corvallis, Oregon. These examples illustrate the importance of coming to understand cause-and-effect relationships in goose ecology and the equal importance of accepting responsibility for indicated management decisions. [Authors' abstract]

57. _____, and H. K. Nelson. 1964. Honkers large and small. Pages 109-124 in Linduska, J. P., ed. Waterfowl Tomorrow. U. S. Fish and Wildl. Ser. Washington D. C. 770pp.

Presents a brief description of the dusky Canada goose and its range. [BHC]

58. Hatler, D. F. 1973. An analysis of use by waterfowl, of the tide flats in southern Clayoquite Sound, British Columbia. Canadian Wildl. Ser. Rep. 134pp.

Suggests that the dusky goose is the most common goose in Clayoquite Sound during fall migration. Presents a synopsis of the history of waterfowl and human use of the Sound. The number of geese using the sound has apparently declined due to human disturbance. Areas of use, activity patterns, and influence of various types of disturbance on migrating geese in Clayoquite Sound are presented. Recommendations for rectifying the problem and increasing goose use during fall migration are made. [BHC]

59. Havel, L. H. 1984. Formation of feeding flocks during winter by dusky and Taverner's Canada geese in Oregon. M. S. Thesis. Oregon State Univ., Corvallis. 81pp.

Behavior and environmental variables influencing the formation of flocks of dusky (Branta canadensis occidentalis Baird) and of Taverner's Canada geese (B. c. Taverneri Delacour) were studied on Sauvie Island,

DRAFT

Oregon, during winter (Oct-Apr) 1981-82. Geese occurred most frequently (80%) in skeins segregated according to subspecies affinity (at least 91% dusky or least 90% Taverner's). In contrast, subspecies composition of feeding flocks (flocks of feeding geese) was frequently (73%) mixed (11-90% dusky/10-89% Taverner's). During waterfowl hunting season, skeins composed of at least 90% Taverner's contained more geese, started approach and landing behaviors at higher elevations, circled more times before landing, and took a longer time to land than skeins composed of at least 91% dusky ($P < 0.001$, all variables). On the average, skeins of Taverner's approached larger fields, containing more geese, and located farther from a roost lake than skeins of dusky ($P < 0.001$, all variables). Out of landing skeins composed of mixed subspecies, a dusky Canada goose was the first bird to land more frequently than expected ($P < 0.001$) and a Taverner's Canada goose was the last bird to land more frequently than expected ($P < 0.001$). Taverner's frequently use fields on privately owned land, while dusky were more often associated with fields on a state wildlife management area. I could determine no patterns for the relationships between subspecies composition of feeding flocks and/or skeins and distance of a field to danger, field crop, amount of water visible in a field, weather variables, time of day, or response to disturbance.

Taverner's Canada geese exhibited significant "seasonal" changes in patterns of behavior and use of fields from waterfowl hunting season to post-hunting season. No significant changes were noted for dusky Canada geese between "seasons." It is hypothesized that the observed differences between dusky and Taverner's Canada geese (within and between "seasons") contribute to differential hunting vulnerability of these subspecies and to the inhibition of pair formation between individuals of different subspecies where these sub-species winter sympatrically.

[Authors' abstract]

60. _____, and R. L. Jarvis. 1988. Formation of feeding flocks during winter by dusky and Taverner's Canada geese in Oregon. Pages 91-101 in Weller, M. W., ed. Waterfowl in Winter. Univ. of Minnesota Press, Minneapolis, 624pp.

See No. 59 for abstract.

61. Hawkins, J. S. 1982. Migration and habitat relationships of geese on the eastern Copper River Delta, Alaska. M.S. Thesis. Univ. Alaska, Fairbanks. 113pp.

Migration and staging of geese were studied on the eastern Copper River Delta, Alaska, from 1978 to 1989. Spring migration occurred from mid-April to mid-May, and autumn migration from mid-August to at least mid-October. Branta canadensis taverneri and B. c. occidentalis were the most abundant taxa in both seasons. Saltmarsh was the most important spring and autumn habitat. Freshwater Meadows, which were Saltmarsh before the 2.5-m uplift during the 1964 Alaska Earthquake, are now characterized by tall vegetation, including shrubs, and were used intensively only by B. c. occidentalis during September. B. c. occidentalis ate many plants in autumn, most importantly Equisetum arvense, Triglochin palustris, and Carex lyngbyaei. Foods were predominantly leaves in August and seeds and roots in September. Visible migration was most correlated with fair weather and associated headwinds and crosswinds in spring, and with the most favorable southwest winds in autumn.

[Authors' abstract]

62. Hellmayr, C. E., and Conover. 1948. Catalogue of birds of the Americas and the adjacent Islands in the Field Museum of Natural History. Field Mus. Nat. Hist., Zool. Ser., 8 (part 1, no. 2):1-434.

Lists specimens in the Field Museum and Conover Collections both housed in the Field Museum. A total of 14 specimens of the dusky goose are listed from the following localities: Alaska (Craig, 2), British Columbia (Graham Island, 4; Queen Charlotte Islands, 8; Vancouver Island, 2; Swanson's Bay, 1). These specimens were placed under Branta leucopareia occidentalis [JEC]

63. Henny, C. J. 1967. Population characteristics of the dusky Canada goose as determined from banding data. M.S. Thesis. Oregon State Univ., Corvallis. 98p.

Banding data for the dusky Canada goose (Branta canadensis occidentalis) on file at the Bird Banding Laboratory, Laurel, Maryland were analyzed to determine population characteristics of this goose. Banding programs have been conducted on the nesting grounds of this subspecies in southcentral Alaska by the U. S. Fish and Wildlife Service and the Alaska Department of Fish and Game. Between 1952 and 1965, 5,758 geese were banded and 1,553 bands were recovered and reported to the Bird Banding Laboratory.

Analysis of band recovery locations indicated that the race has a well-defined migration route and restricted wintering areas. Exodus from the nesting grounds in

DRAFT

Alaska begins about 15 September and the birds arriving in the central Willamette Valley of Oregon (major wintering area) about 5 November. The geese remain in the valley until approximately 10 April; they then return to the Copper River Delta of Alaska to nest. Nesting begins about 1 May.

The size of the winter dusky Canada goose population in Washington and Oregon has averaged 18,078 for the last four years (1964-67). Sixty-five % of the dusky Canada geese harvested are taken in Oregon; 16 % in British Columbia, 11 % in Washington, 8 % in Alaska, and a trace in California. An average of 45.3 % of the population is killed annually (1952-65). However, population mortality rates have been increasing; immature rates are now in excess of 60 %. The annual mortality rates in the flyway are correlated with season lengths and bag limits in Oregon. This may be a result of two-thirds of the harvest occurring in that state. Hunting club members and their guests harvested as estimated 65 % of the dusky Canada geese taken in Oregon in 1965. One large club accounted for 36 % of the harvest.

Considering the average population mortality rates (1952-64), it was estimated that between 50 and 66 % of the subadult females must attempt to nest with an 85 to

90 % nest success just to maintain a stable population. This percentage is considerably higher than those recorded in the literature for other races of Canada geese.

In view of the population size, the present mortality rates, the environmental changes on the breeding grounds, and the production rates necessary to maintain a stable population, it was concluded that more restrictive hunting regulations were necessary to maintain the population at the present level.

Advantages and disadvantages of possible restrictive hunting regulations are discussed. [Authors' abstract]

64. _____ . 1967. Estimating band-reporting rates from banding and crippling loss data. J. Wildl. Manage. 31:533-538.

A new method for estimating band-reporting rates (proportion of bands recovered by hunters that are reported to the Bird Banding Laboratory) is described. This method is dependent upon components obtained from banding data (direct recovery rate, annual mortality rate, and annual natural mortality rate) and crippling loss information. These data are to a large degree already available for waterfowl. The results obtained in my example, involving data from dusky goose (Branta

canadensis occidentalis are in close agreement with band-reporting rates determined for other subspecies of geese in 1966 by Martinson and McCann who used a mail questionnaire survey. The band-reporting rate for the subspecies studies as declined significantly from 49.1 % for the period 1953-60, to 33.2 % in 1962 and 1963. [Author's Abstract]

65. Jarvis, R. L. and R. S. Rodgers. 1976. The dusky Canada goose - a new Minority? Rep. to Dusky Canada Goose Subcommittee. Pac. Flyway Study. Committee. 18pp.

This was the first of a series of annual reports on the status of dusky Canada geese on the wintering grounds. The conclusions were that the subspecies composition of Canada geese wintering the Willamette Valley and lower Columbia River was changing, the proportion of Taverner's Canada geese was increasing, and dusky Canada geese was more vulnerable to hunting than Taverner's geese. The proportion of adult dusky geese harvested increased as the season progressed and was particularly large when the season extended into January. Further conclusions were that there was relatively little information available on Taverner's Canada geese and that improved methods of determining harvest statistics are desirable. [JEC]

66. _____, and R. S. Rodgers. 1977. The dusky Canada goose - a new minority! Rep. to Dusky Canada Goose Subcommittee. Pac. Flyway Study Committee. 14pp.

Second in the series of annual reports. Results of field observations indicated equal numbers of dusky and Taverner's Canada geese at about 24,000 birds during 1976-1977. This was an increase in Taverner's geese of 40% from 1975-1976. The mid-winter population estimate for dusky's was 24,000 Dusky harvest was about 5,000 birds. The percent of adult duskys in the harvest did not rise as sharply towards the end of the season as it did in 1975-1976. It was suggested that the Taverner's population may continue to increase to the point that, in four or five years, dusky's would comprise only 25% of the population. The need for innovative harvest regulations to increase the harvest of Taverner's geese while affording some protection to duskys was identified. Use of aerial photography for determination of subspecies composition of goose flocks was also recommended. [JEC]

67. _____. 1978. The dusky Canada goose: an entrenched minority! Rep. to Dusky Canada Goose Subcommittee. Pac. Flyway Study Committee. 14pp.

DRAFT

During the winter of 1977-1978, about 53 % of the Canada geese on the winter grounds were duskys, 46 % were Taverner's and 1 percent were lessers and cacklers. Thirty percent of the total geese were at Sauvie Island, 30 % at Ankeny NWR, 20 % at Baskett Slough NWR, and 20 % at Finley NWR. At Finley NWR and Baskett Slough NWR duskys predominated, but the majority of the geese at Sauvie Island and Ankeny NWR were Taverner's. Duskys arrived earlier in the fall than Taverner's geese. The best estimate of mid-winter goose numbers was 26,000 duskys and 34,000 Taverner's. The Taverner's estimate was an increase of 42 % from the winter of 1976-77.

Of the geese harvested on the three Willamette Valley Refuges, 76 % were duskys and 20 % were Taverner's indicating that duskys are 2.5 to 5 times more likely to be harvested than Taverner's geese. [JEC]

68. _____ . 1980. Status of dusky and Taverner's Canada geese in the Willamette Valley. Rep. to Dusky Canada Goose Subcommittee. Pac. Flyway Study Committee. 9pp.

The mid-winter estimate for Canada geese in the Willamette Valley for 1980 was 67,500. Of those 22,000 were duskys and 45,500 were Taverner's geese. Since

DRAFT

1976, the Taverner's goose numbers have increased by an average rate of 25.2 % per year, while dusky geese have declined an average of 0.8 %. Over that same period 0.85 immature duskys were harvested on Willamette Valley refuges for each adult, but 1.05 immature Taverner's geese were harvested for every adult. During the last five years harvest of geese has declined at Baskett Slough NWR and increased at Finley NWR. The proportion of Taverner's geese in the harvest has increased and the proportion of duskys has decreased. However the harvest rate of Taverner's geese has not increased as much as the rate of increase of the Taverner's population. Some testing of aerial photography was completed this winter to estimate subspecies composition of wintering goose flocks.

[JEC]

69. _____, and P. Sekora. 1981. Status of Canada geese Wintering in Oregon - Southwestern Washington. Rep. to Dusky Canada Goose Subcommittee. Pac. Flyway Study Committee. 8pp.

The number of Canada geese peaked at an estimated 72,000 geese in early December. In early January the mid-winter estimate was about 63,300. This decrease has occurred consistently in recent years, presumably due to dispersal of geese from concentrations on

refuges. Dispersed geese are much more difficult to locate and to count. About 32 % of the winter goose population was duskys and about 68 % was Taverner's. Total goose harvest was slightly higher than the previous year, but the proportion of duskys in the harvest decreased. Age ratios in the harvest were 0.91 young duskys/adult compared to 1.67 young Taverner's/adult. [JEC]

70. _____ . 1982. Status of Canada geese Wintering in Western Oregon - Southwestern Washington. Rep. to Dusky Canada Goose Subcommittee. Pac. Flyway Study Committee. 9pp.

The dusky Canada goose population declined 22.8 % in the last year to an estimated 17,750 geese. At the same time Taverner's geese continued to increase to 56,700, 15.7 % more than the year before. Total Canada geese peaked at 74,600 in February. The large number of geese counted in November (72,700) was unusual and probably reflected an early migration. The harvest rate on duskys was apparently quite high; the harvest estimate was 9,250 or 34.3 % of the estimated fall flight. Over the past 10 years, the harvest rate for duskys averaged 25 %. [JEC]

71. _____ . 1989. Estimated mid-winter population of dusky Canada geese, 1988-89. Rep. to the Dusky Canada Goose subcommittee. Pac. Flyway Study Committee. 4pp.

The 1988-89 mid-winter population of dusky geese was estimated at 11,800 birds or 20.1% of the estimated 58,600 wintering Canada geese in western Oregon and southwestern Washington. While the number of dusky geese apparently was similar to 1987-88, the overall number of geese wintering in the willamette Valley was down by nearly 12,00 birds. Suggests that Taverner's Canada goose numbers may also be declining. [BHC]

72. _____, and J. Cornely. 1983. Status of Canada geese wintering in western Oregon-Southwestern Washington: Report to the Dusky Canada Goose subcommittee. Pac. Flyway Study Committee. 7pp.

The dusky population was the lowest since before 1971 and continuing to decline. The total number of geese in the area peaked at about 62,000, a 17 % decrease from 1981-1982. An estimated 17,000 dusky and 45,000 Taverner's were present during the mid-winter period. Age ratios of both dusky and Taverner's geese suggested poor production in 1982. Harvest for dusky was about average as a proportion of the fall flight but exceeded production. Suggestions on how to

increase hunting pressure on the Taverner's population were made. [JEC]

73. _____. 1988. Recent changes in wintering populations of Canada geese in Western Oregon and southwestern Washington. Pages 517-528 in M. W. Weller, ed. Waterfowl in Winter. Univ. Minnesota Press, Minneapolis, 624pp.

Despite management priority, numbers of dusky Canada geese (Branta canadensis occidentalis) declined from 20,000-25,000 in the 1970s to 10,000 in 1984. Beginning in the early 1970s Taverner's Canada geese (B. c. taverneri) increased from a few thousand to 55,000-60,000 in the mid-1980s and now compose 85% of the combined wintering flock of about 70,000 geese. Recruitment of dusky geese declined from an average of 28% juveniles in the fall population before 1979 to about 19% since 1979. Recruitment of Taverner's is unknown, but juveniles constituted a larger proportion of the harvest of Taverner's geese. Managers face a difficult task restoring the number of dusky geese to former levels because of low recruitment and high vulnerability to hunting. The large, thriving population of Taverner's geese compounds the difficulties of protecting the small, unprosperous population of dusky geese. [From authors' abstract]

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74. Jewett, S. C. 1932. The white-checked geese in Oregon. Condor 34:136.

Documents occurrence of the subspecies B. c. occidentalis on the Oregon coast. States that the dusky goose "wanders south from Alaska during late fall at least to the coast of Oregon and into the Willamette Valley". [BHC]

75. _____, S. G., W. P. Taylor, W. T. Shaw, and J. W. Aldrich. 1953. Birds of Washington State. Univ. Washington Press, Seattle. 767pp.

List B. c. occidentalis as a migrant and winter visitant along the coastline. In addition to the type specimen, the following specimens are listed: 2 from Camp Simiahmoo, specimens from Puget Sound, Camp Lopez (22 Jan. 1860), and Protection Island. Reported that Gabrielson saw several small flocks of "very dark" but large geese on Skagit Flats on 18 January 1934. Jewett observed a lone goose at Copalis on 6 December 1941 that he believed to be occidentalis [JEC]

76. Johnson, D. H., D. E. Timm and P. F. Springer. 1979. Morphological characteristics of Canada geese in the Pacific Flyway. Pages 56-87 in R. L. Jarvis and J. C.

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Bartonek eds. Management and biology of Pacific Flyway geese. OSU Book Store, Corvallis.

The specific status of Canada geese (Branta canadensis) is a contentious matter of importance to both taxonomists and wildlife managers. In this report we consider the six subspecies that breed in Alaska. We quantitatively examine a variety of morphological measurements taken on 1345 Canada geese believed to be sedentary on breeding or wintering areas. From this information we develop general descriptions of each subspecies. We find that various combinations of morphological characters can more reliably distinguish subspecies than can single characters, and we develop discriminant functions for this purpose. The affinities of the various subspecies, based upon our analysis, are discussed (Authors' abstract). Discriminate function analysis of measurements for dusky and Vancouver geese are presented and available for these 2 similar subspecies with potentially overlapping ranges. [BHC]

77. Kafka, D. M. 1988. 1988 dusky Canada goose monitoring report, Copper River Delta, Alaska. U. S. Forest Serv Rep. Cordova, AK. 13pp.

DRAFT

A total of 480 artificial nest island were available to nesting dusky Canada geese in 1988. Fifty five nesting attempts on these islands were documented, 22 on sandbag islands, 23 on fiberglass floaters, 3 on barrel islands, 5 on inner tube floaters and 2 on platform islands. No nesting attempts were recorded on dish structures. Forty (73%) attempts were successful, 6 (11%) nests were being incubated and 9 (16%) nests were destroyed by predation. Of the 9 nests destroyed, 2 were destroyed by birds, 1 by coyotes, 5 by bears and 1 was destroyed by an undetermined predator. Sandbag islands and fiberglass floaters were the preferred structure type for nesting. In addition, they have received the greatest amount of use from 1984 to 1988 (19%). [BHC]

78. Klein, D. R., R. W. Ingebo, F. C. Robards, H. King and J. Walker. 1955. Pages 30-33 in U. C. Nelson, Fed. Aid Leader. Copper River Delta Banding and Production studies. Alaska Game Commission Quarterly Rep. U.S. Fish and Wild. Serv. Fed. Aid Wildl. Rest. Prog. Rep. 10(1):1-78. Juneau.

Summary of production surveys and banding studies in 1955. A total of 413 molting geese were captured and banded. Nesting was estimated to be 2 weeks later than usual due to poor spring conditions. Evidence of

DRAFT

re-nesting was common. Some nest mortality apparently resulted from flooding by severe storm tides in June. Brown bears, gulls, and jaegers were seen on the flats but no evidence of predation was observed. Broods averaged 4.2 goslings (N=104). [BHC]

79. _____, R. Ingebo, and D. Little. 1956. Migratory waterfowl studies - Copper River Delta, banding and production studies. Pages 3-6 in R.F. Scott, Supervisor. Alaska Game Commission Quarterly Rep. U. S. Fish and Wildl. Serv. Fed. Aid Wildl. Rest. Prog. Rep. 11(1):1-20. Juneau.

Summary of production surveys and banding studies in 1956. A total of 405 molting geese were captured and banded. While spring was late, production was apparently good. There was little evidence of re-nesting or nest losses to storm tides. Also, possibly due to local spring ice conditions, an apparent shift in the distribution of nesting geese away from Alaganik and King Salmon Sloughs to Story and Government Sloughs was noted. Average brood size was 5.5 goslings (N=27). Of the nesting platforms constructed in the Pete Dahl Slough area in 1954, 3 were used by geese and 7 by gulls for nesting. [BHC]

80. Leach, B. 1982. Waterfowl on a Pacific estuary.
British Columbia Provincial Mus. Spec. Publ. 5:1-211.

While the dusky goose may have occurred more frequently on the lower Fraser River in the past, it is seldom reported there today. The decline in use of the Fraser Valley by migrating geese is attributed to habitat loss and hunting pressure. [BHC]

81. Lebeda, C.S., and J.T. Ratti. 1983. Reproductive biology of Vancouver Canada geese on Admiralty Island, Alaska. J. Wild. Manage. 47:297-306.

Cited in discussion of dusky goose taxonomy.

Recognized B. c. fulva as a subspecies of Canada geese.
[BHC]

82. Lowe, R. W. 1987. Coastal Canada geese: a preliminary report. Oregon Birds 13:145-145.

Wintering flocks of dusky geese have been observed at Pacific City, Nestucca Bay, and Brookings on the Oregon coast and at the mouth of Smith River on the northern California coast. These flocks numbered approximately 60, 400-500, 60, and 100 birds, respectively in 1987. Pastures associated with dairy farms appear to be important winter habitat. [BHC]

83. Macoun, J. and J. M. Macoun. 1909. Catalogue of Canadian birds. Canada Dept. Mines, Geol. Surv. Branch. Ottawa. 761pp.

[ONS]

84. McKnight, D. E. 1971. Report of survey and Inventory Activities. Part III - Waterfowl and small game. Vol. II. Alaska Dept. Fish and Game. Fed. Aid Wildl. Rest. Prog. Rep. Proj. W-17-3, Jobs 10 and 11. Juneau. 52pp.

Summary of information collected on the nesting grounds in 1970. Of 164 dusky goose nests sampled, 88.2% were successful, 3.2 % abandoned, and 8.6 % destroyed. Average clutch size for 146 nests was 5.4 eggs. Two hundred and ninety six eggs were measured and averaged 81.68mm x 55.76mm. [BHC]

85. Mickelson, P.G., J. S. Hawkings, D. R. Herter, and S. M. Murphy. 1980. Habitat use by birds and other wildlife on the eastern Copper River Delta, Alaska. U.S. Forest Service Rep. Anchorage. 189pp.

Habitat preference, distribution, abundance, and phenology of nesting and migrating birds on the east

DRAFT

Copper River Delta (ECRD) were described during 1978-1979. The ECRD appeared to be an important fall staging area for dusky geese. From early August to mid-October staging geese first used the saltgrass meadows for feeding and loafing but later moved to wet meadows. The ECRD was lightly used by geese during spring migration. [From Authors' abstract]

86. Moffit, J. 1937. The white-checked goose in California. Condor 39:149-159.

First documentation of the subspecies B. g. occidentalis in California. Reports observations of occidentalis along the northern coast of California and habitats used by these birds during the winter. [BHC]

87. _____. 1939. Notes on the distribution of whistling swan and Canada goose in California. Condor 41:93-97.

Cited in discussion of dusky goose taxonomy. Used common name white-cheeked goose for B. g. occidentalis. [BHC]

88. Morgan, R. P. II, S. T. Sulkin, and C. J. Henny. 1977. Serum proteins of Canada goose (Branta canadensis). Condor 79:276-278.

Serum proteins from 9 subspecies of Canada geese were analyzed through electrophoresis. Variation was minimal within a subspecies, although all the subspecies were closely related. The Aleutian Canada goose appeared to be the most distinct subspecies, while giant and western Canada geese were the most similar. Results suggest that electrophoresis techniques are sensitive enough to identify some subspecies, however, baseline data from breeding ranges of all subspecies are needed. [BHC]

89. Nelson, U. C. 1952. Copper River Delta banding operations - July 15-25, 1952. Pages 10-12 in U. C. Nelson, Fed. Aid Leader. Alaska Game Commission Quarterly Rep. U. S. Fish and Wildl. Serv. Fed. Aid Wildl. Rest. Prog. Rep. 7(1):1-45. Juneau.

Summary of production surveys and banding studies in 1952. A total of 148 molting geese were captured and banded. Estimated 4,000 geese nesting on the delta plus 2,000 non-breeders. Nests were found primarily on the highest points of slough banks from the coast to 10 mi. inland. Nesting sites were in the driftwood line in vegetation dominated by wild iris, shooting star, and salt grass. Average brood size was 5.4 goslings (N=9). While glaucous and short-billed gulls, bald eagles,

DRAFT

short-eared owls, unidentified hawks, and brown bears were observed on the nesting grounds, no evidence of predation were found. [BHC]

90. Olgilvie, M.A. 1978. Wild Geese. Buteo Books. Vermillion, S.D. 350pp.

Cited in discussion of dusky goose taxonomy. Considers both the dusky goose and Vancouver goose the same subspecies (B.c. occidentalis). [BHC]

91. Olson, S. T. 1954. Copper River Delta banding operations. Pages 34-42 in U. C. Nelson, Fed. Aid Leader. Alaska Game Commission Quarterly Rep. U.S. Fish and Wildl. Serv. Fed. Aid Wildl. Rest. Prog. Rep. 8(1):1-91. Juneau.

Summary of production surveys and banding studies in 1953. A total of 482 molting geese were captured and banded. Peak of hatch was reported to have been between June 20-25. Average brood size was 4.3 (N=31). No evidence of nest destruction by predators was observed. Bear tracks were observed and it was hypothesized that bears foraging along high slough banks could "go from nest to nest and in a very short period clean out the bulk of the nesting in an area during the height of nesting." Coyote tracks were observed, primarily

inland near the heads of glacial streams. Glaucous-winged gulls were common but the contents of 29 stomachs indicated little predation on waterfowl. Goshawks were occasionally seen. A jaeger was observed harassing adult geese. An experimental attempt to sex geese by the profile of the head was unsuccessful. Also, as an experiment to see if nest losses to high tides could be reduced, 50 nesting platforms were constructed from sod along Pete Dahl Slough. [BHC]

92. _____. 1954. Migratory waterfowl studies: Copper River Delta, banding and production studies. Appendix B in U. C. Nelson, Fed. Aid Leader. Alaska Game Commission Quarterly Rep. U.S. Fish and Wildl. Serv. Fed. Aid Wildl. Rest. Prog. Rep. 9(1):1-73. Juneau.

Summary of production surveys and banding studies in 1954. A total of 752 geese were banded in July. The sex ratios for adult geese was equal but juveniles had a ratio favoring males (112:100). Nesting was reported to be 1 week late with peak of hatch occurring in late June. Average brood size ranged from 4.4 (N=21) for class I broods to 6.3 (N=6) for class II broods. While evidence of brown bears were common on the flats, no evidence of predation were observed. Coyotes were present inland of the flats and some predation by them may have been possible. Glaucous-winged gulls were

DRAFT

reported to be common but the examination of 5 stomachs showed no evidence of predation. Sod platforms built in 1953 had withstood the "elements" well. They had been used as roosts by geese but there were no evidence of nesting. The remains of geese were found on or near 4 platforms suggesting that birds roosting on the structures were vulnerable to predation by coyotes or eagles. [BHC]

93. Osgood, W. H. 1901. Natural history of the Queen Charlotte Islands, British Columbia. No. Amer. Fauna 21:51-81.

First record of the subspecies B. c. occidentalis on Queen Charlotte Island, Canada. Speculated that dusky nested on island. [BHC]

94. Owen, M. 1980. Wild geese of the World. B.T. Batsford, Ltd. London. 248pp.

Cited in discussion of dusky goose taxonomy.

Considered the dusky goose and Vancouver goose races of the same subspecies of Canada goose (B. c. occidentalis). [BHC]

95. Pacific Flyway Council 1973. Guidelines for management of the dusky Canada goose, 12pp.

Establishes a dusky Canada goose Sub-committee of Pacific Flyway Technical Committee and management plan for the dusky goose. Geese will be managed on a sustained yield basis. Management practices will be designed to achieve maximum post season populations that are compatible with public tolerance of goose depredations on the wintering grounds, available food, and carrying capacity of the breeding grounds. The post-season population objective of 20,000-25,000 dusky geese, as determined from mid-winter inventories in Oregon and Washington was established. [BHC]

96. _____. 1985. Dusky Canada goose management plan. Pacific Flyway Council. 23pp.

Current management plan for the dusky goose. Sets four management objectives: a) to achieve and maintain a wintering population of 20,000 dusky geese (3 year average) as part of an overall wintering Canada goose population in northwestern Oregon and southwestern Washington of at least 40,000 but no more than 75,000. b) maintain nesting migration, and wintering habitats in sufficient quantity and quality to meet and maintain the population objective. c) manage the wintering habitat to provide optimum food, water, and sanctuary conditions for dusky geese and to provide optimum

geographical distribution of geese. d) manage the dusky goose and other Canada goose populations to provide optimal hunting and other recreational uses. Recommends management procedures and research to obtain management objectives. [BHC]

97. Palmer, R.S. 1976. Handbook of North American Birds. Vol. 2. Yale Univ. Press. London. 521pp.

Cited in discussion of the taxonomy of the dusky goose. Considered the dusky goose and Vancouver goose the same subspecies (B.g. occidentalis). Summarizes natural history, physical characters, distribution and migration of this coastal goose of British Columbia and Alaska. [BHC]

98. Pollard, R. 1984. A report on the field evaluation of dusky Canada goose artificial nest islands on the Copper River Delta, Alaska. U. S. Forest Service Rep. Cordova, AK. 23pp.

Described design, installation, and use of three types of experimental artificial nesting islands on the Copper River Delta. Eight of 39 islands were used by dusky geese, the first year after installation, 5 for nesting and 3 for resting. All 5 nests were successful. [BHC]

99. Potyondy, J. P., M. P. Meyer, and A. C. Mase, Jr.
1975. Hydrologic response of the Copper River Delta-
Controller Bay Area, Alaska to land emergence and
uplift. Univ. Minnesota, St. Paul. 81pp.

Aerial photo interpretation was used to determine the effects of the March 27, 1964 earthquake on the vegetation and hydrology of the Copper River Delta, Alaska. A drainage network map, emphasizing hydrologic characteristics, and a vegetation map, emphasizing vegetation, were developed for an intensive study area encompassing almost 60 square miles. Pond characteristics were classified and a computer mapping program written to help analyze the data. The major change due to tectonic uplift is the transformation of brackish water ponds to freshwater ponds and its subsequent effect on aquatic vegetation. In that portion of the Delta that was previously flooded by tides, pond vegetation has decreased because nutrient rich brackish water has been replaced by relatively sterile rain water. Ponds which were never flooded by the tides are continuing toward their normal successional climax. The levee vegetation paralleling the sloughs and gullies is expanding and being invaded by shrubs as this site is now drier and less saline than during pre-earthquake conditions. The drainage

DRAFT

network has not been altered because it was well established at the time of the earthquake but stream and gully downcutting to new equilibriums has occurred. Pond losses due to the earthquake are relatively minor. Only three percent of the ponds have been drained or suffered large decreases in surface area. The greatest effect is reflected in vegetation changes. These changes may have adverse effects on the waterfowl nesting on the Delta. [Author's abstract]

100. _____ . 1975. An analysis of 1964 earthquake effects upon vegetation and hydrology of the Copper River Delta, Alaska. Univ. Minnesota, St. Paul. 84pp.

Aerial photo interpretation was used to determine the effects of the March 27, 1964 earthquake on the vegetation and hydrology of the Copper River Delta, Alaska. A drainage network map, emphasizing hydrologic characteristics, and a vegetation map, emphasizing vegetation, were developed for an intensive study area encompassing almost 60 square miles. Pond characteristics were classified and a computer mapping program written to help analyze the data. The major change due to tectonic uplift is the transformation of brackish water ponds to freshwater ponds and its subsequent effect on aquatic vegetation. In that portion of the Delta that was previously flooded by

tides, pond vegetation has decreased because nutrient rich brackish water has been replaced by relatively sterile rain water. Ponds which were never flooded by the tides are continuing toward their normal successional climax. The levee vegetation paralleling the sloughs and gullies is expanding and being invaded by shrubs as this site is now drier and less saline than during pre-earthquake conditions. The drainage network has not been altered because it was well established at the time of the earthquake, but stream and gully downcutting to new equilibriums has occurred. Pond losses due to the earthquake are relatively minor. Only three percent of the ponds have been drained or suffered large decreases in surface area. The greatest effect is reflected in vegetation changes. These changes may have adverse effects on the waterfowl nesting on the Delta. [Author's abstract]

101. Reimnitz, E. 1972. Effects on the Copper River Delta. Pages 290-302 in The great Alaska earthquake of 1964: oceanography and coastal engineering. Nat. Acad. Sci. Publ. 1605.

The Copper River Delta was uplifted an average 2m by the 1964 earthquake. Based on carbon dating of submerged forests, the delta has probably been uplifted by strong earthquakes 700 and 1,000 years B.P.

Subsidence after these uplifts was apparently slow and not due to catastrophic events. [BHC]

102. Riley, L. and W. Riley. 1979. Guide to the National Wildlife Refuges. Anchor Press. Garden City, New York. 653pp.

This guide notes that William L. Finley, Ankeny, and Baskett Slough National Wildlife Refuges in the Willamette Valley, Oregon, were established in 1964 and 1965 to help safeguard the dusky Canada goose. Canada geese can almost always be seen in refuge fields during the winter. [JEC]

103. Scheierl, R., and M. Meyer. 1976. Evaluation and inventory of waterfowl habitats of the Copper River Delta, Alaska, by remote sensing. Univ. Minnesota, St. Paul. 46pp.

A 35mm aerial photography system was tested on the Copper River Delta, Alaska, to establish baseline data for monitoring waterfowl habitat and related vegetation and hydrologic changes occurring there, especially those resulting from the Alaskan Earthquake of 1964. Flights were made over 17 permanently-established transects using various film/filter combinations at different times of the year to arrive at an optimum

DRAFT

resolution. It was concluded that 1:3,2000 scale color photography, supplemented with color infrared Wratten 12 filter photography of similar scale flown approximately August 1st, provides the best aquatic vegetation differentiation. Color infrared Wratten 12 filter 1:3,200 scale photography was found to best portray upland vegetation, when supplemented with color photography of similar for detection and recognition. It was not possible to differentiate alder from willow during this study, but it may be possible to do so in the future with autumn photography. The 35mm aerial photography system was deemed to be practical as a field level resource monitoring tool from the standpoint of: (1) resource data collection capabilities, (2) modest cost of operation, and (3) operational feasibility under normal (often adverse) field and weather conditions.

Additionally, 1:15,840 scale vegetation maps were compiled from (interpreted) 9x9-inch format color photographs of similar scale for over 110 square miles of the Copper River Delta - adjacent to the area mapped the previous year. [Author's abstract]

104. Sellers, D. 1980. Copper River Delta Waterfowl update. Proceedings of the Eighth Copper River Delta Conference. p.6.

Reports a dusky goose nest success of 7% in 1980.

Predation was the primary reason for poor nest success with most of the nest losses attributed to brown bears. The calculated nest density was 134 nests per sq. mi. and average clutch size was 5.4 eggs. [BHC]

105. Shepherd, P. E. K. 1961. Mortality studies of western Canada geese - Copper River Delta. Annual Report of 1960-1961 segment, Vol. 2. Alaska Dept. Fish and Game. Fed. Aid Wildl. Rest. Prog. Rep. W-6-R-2, Job 3-a. Juneau. 77pp.

Summary of information collected on the nesting grounds in 1960. A substantial increase in the number of geese on the Copper River Delta was reported but no supportive data given. Discusses capture techniques used to catch 619 dusky geese for banding. [BHC]

106. _____. 1962. Production, Harvest distribution and migration of waterfowl in Alaska. Alaska Wildl. Invest. Job Comp. Rep. Research Proj. Segment. Fed. Aid in Wildl. Rest. Proj. W-6-R-3, Job. 3-C. Juneau 112pp.

Summary of information collected on the nesting grounds in 1961. Reports that goose production good with a

DRAFT

noticeable increase over the 1957, 1958, and 1959 populations. No data to support the report presented.

[BHC]

107. _____. 1965. Waterfowl report. Vol. VI. Alaska Dept. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-6-R-5 and 6, Work Plan H, Jobs 1,2 &3. Juneau. 16pp.

Investigations of the immediate effects of the Good Friday earthquake on the Copper River Delta suggested that the vertical land uplift of 6 feet may cause changes in the aquatic and terrestrial plant ecology. Reported changes in flight and feeding patterns of waterfowl are suspected to be in response to tidal changes resulting from the earthquake. The delayed spring rather than the earthquake was responsible for lowered production. [From author's abstract]

108. _____. 1965. A preliminary evaluation of earthquake damage to waterfowl habitat in Southcentral Alaska. 45th Ann. Conf. West. Assoc. State Game and Fish Comm. 9p.

After uplifting of the Copper River Delta by 6 feet during the March 1964 earthquake, many sloughs and ponds began drying up. Large expanses of intertidal

mudflats have also been exposed and are now flooded by only the highest tides. Nest losses to flooding have been reduced but access to nesting grounds for mammalian predators has improved. Coyotes and other mammals have become increasingly abundant on the nesting grounds and nest predation has increased. Nest success has declined from 89% in 1959 to 82% in 1964 and 58% in 1965. Conversely, nest predation has increased from 1.3% in 1959 to 10% in 1964 and 30% in 1965. [BHC]

109. _____ . 1966. Waterfowl Report. Vol. VII. Alaska Dept. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-6-R-6, work Plan H and W-13-R-1, Work Plan C. Juneau. 28pp.

Summary of information collected on the nesting grounds in 1965. Presents initial post-earthquake habitat information. Of 221 nests, 139 were successful, 15 abandoned, and 67 were destroyed. Mammalian predators were responsible for most of the nest losses with no losses attributed to flooding. Microtine population had increase considerably since 1964 and may be attracting mammalian predators. Speculated on the future need for predator control. Average clutch size (N=140) was 5.8 eggs. [BHC]

110. _____, E. K., B. L. Hilliker, and R. J. Somerville. 1967. Waterfowl Report. Vol. VIII. Alaska Dept. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-13-R-1 and 2, Work Plan C. Juneau. 27pp.

Summary of information collected on the nesting grounds in 1966. Reports second year results of studies to determine the effect of land uplifting on the production of waterfowl and to inventory, catalogue, and map habitat. Dusky goose nesting success (N=100) was 97.0% with 3% abandoned and very little nest destruction. [BHC]

111. _____, B. L. Hilliker, and J. H. Crow. 1968. Waterfowl Report. Vol. IX. Alaska Dept. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-13-R-2 and 3, Work Plan C. Juneau. 39pp.

Summary of information collected on the nesting grounds in 1967. Reports third year results of studies to determine the effect of land uplift on the production of waterfowl. No dusky goose nest success or clutch size data collected. Production, based on a July aerial survey, was 35% young. [BHC]

112. Simpson, G. S. 1979. Comparative ecology of several subspecies of Canada geese during winter in Western Oregon. M.S. Thesis. Oregon State Univ., Corvallis. ___pp.

Distribution, harvest and foraging ecology of Canada geese (Branta canadensis) were studied from October through April, 1975-76 to 1977-78, in the Willamette Valley, Oregon. The relative abundance of Taverner's Canada geese (B. c. taverneri) increased significantly ($P < 0.01$) from 25% in 1975-76 to 50% in 1977-78. Distribution of subspecies was not uniform throughout the study area. Dusky Canada geese (B. c. occidentalis) comprised between 70 and 80% of the harvest each year on refuges. During 1977-78, the percent composition of the harvest was not significantly different on and off refuges. During 1976-77 and 1977-78, dusky were 2.8 and 2.6 times as vulnerable to harvest as Taverner's. Harvest rates and kill rates calculated for dusky were approximately twice those calculated for Taverner's and lesser Canada geese (B. c. parvipes) combined during the 1977-78 hunting season. Differences in vulnerability to hunting were attributed to distribution of the subspecies in relation to hunting pressure, and to differences in flocking behavior. Mean flock sizes and mean sizes of groups arriving in fields were not

significantly different between subspecies, although Taverner's occurred in larger groups more frequently than dusky's. Taverner's used significantly ($P < 0.01$) larger fields than dusky's. [Authors' abstract]

113. _____, and R. L. Jarvis. 1979. Comparative ecology of several subspecies of Canada geese during winter in Oregon. Pages 223-241 in R. L. Jarvis and J. C. Bartonek, eds. Management and biology of Pacific Flyway geese. OSU Book Stores. Corvallis.

See No. 112 for abstract.

114. Swarth, H. S. 1911. Birds and mammals of the 1909 Alexander, Alaska expedition, Univ. Calif. Pub. Zool. 7:9-172.

Reports on observations of Canada geese in southeastern Alaska during the spring and summer of 1909 and on a specimen collected at Thomas Bay on August 14, 1909.

[JEC]

115. _____. 1913. A study of a collection of geese of the *Branta canadensis* group from the San Joaquine Valley, California. Univ. Calif. Publ. Zool, 12:1-24.

DRAFT

Concluded that Branta canadensis occidentalis did not occur in the San Joaquin Valley, California. Swarth presented an excellent discussion of the taxonomic status of western races of Branta canadensis at that time. Prior to this publication, numerous authors referred to the subspecies occidentalis as occurring in California. Supports the recognition of occidentalis, canadensis, hutchinsi, and minima as subspecies of Branta canadensis. Concluded that B. c. occidentalis is a well-defined subspecies occupying the humid, northwest coast region, where it is practically resident performing only limited migrations. [JEC]

116. _____. 1920. The subspecies of Branta canadensis.
Auk 37:268-272.

Defends an earlier publication (Swarth 1913) that divides Canada geese into 4 subspecies, B. c. canadensis, occidentalis, hutchinsi, and minima. [BHC]

117. Taverner, P. A. 1931. A study of Branta canadensis (Linnaeus) The Canada Goose. pages 28-40 in Ann. Rept. Nat. Mus. Canada. 1929.

Taverner concluded that occidentalis was a subspecies of Branta canadensis. Other subspecies were B. c. canadensis and B. c. leucopaeria. He considered Branta

DRAFT

minima and B. hutchinsi as full species. All of the specimens he lists under B. c. occidentalis were juveniles collected in late August or early September in the Queen Charlotte Islands, British Columbia. These birds were probably B. c. fulva and, therefore, the description includes both dusky Canada geese and Vancouver Canada geese. Taverner dropped the use of the common name "white-checked goose" in favor of "western Canada goose" as expressed in its subspecific title.

Taverner concluded that the genetic differences between races of Canada geese may be far wider than is evident from a superficial examination of specimens. He thought that the differences were better observed in the habit, stance, action, and voice of live birds. He reported that experienced sportsmen have less difficulty recognizing the various forms of Canada geese in the field than the systematist has in the laboratory with preserved specimens. [JEC]

118. Thilenius, J. ca 1978. Problem analysis: Ecology of coastal wetlands, Copper River Delta, Alaska. Unpubl. Rep. U. S. Forest Serv. Juneau. 104pp.

DRAFT

Review and critique of literature on the Copper River Delta with emphasis on physical and botanical features.

[BHC]

119. Timm, D. E. 1972. Report of survey-inventory activities-waterfowl. Vol. III. Alaska Dept. Fish and Game. Fed. Aid in Wildl. Rest. Proj. W-17-4, Job 10.0. Juneau. 17pp.

Summary of information collected on nesting grounds in 1971. Estimated nest density 30-50 % below previous years. Seventy-six percent (N=100) of the nests were successful and 24% were destroyed by predators. Average clutch size (N=113) was 3.6 eggs. Young production was estimated at 16.2%. Measurements of 296 eggs were reported and compared to measurements of Vancouver Canada goose and Prince William Sound Canada goose eggs. [BHC]

120. _____, and P. Havens. 1973. Report of Survey and inventory activities - Waterfowl. Vol. IV. Alaska Dept. Fish and Game. Fed. Aid Wildl. Rest. Prog. Rep. Proj. W-17-5, Jobs 10 and 22. Juneau. 64pp.

Summary of information collected on the nesting grounds in 1972. Reported that 73.3% of dusky goose nests (N=135) were in the forb/grass community followed by

19.3% in sedge, 6.7% in sedge/grass, and 0.7% on mud banks. Eighty-one percent of the nests (N=116) hatched and 19.0% were destroyed. Average clutch size (N=57) was 4.4 eggs. About 10.6% of the population was estimated to be composed of young in July. Average culmen tarsus, and culmen + tarsus measurements of 100 geese was reported. [BHC]

121. _____. 1974. Report of survey-inventory activities, waterfowl. Vol. V. Alaska Dept. Fish and Game Fed. Aid Wildl. Rest. Prog. Rep. Proj. W-17-5, Jobs 10 and 22. Juneau. 64pp.

Summary of information collected on the nesting grounds in 1973. No formal nesting studies were conducted but random sampling of 48 nests indicated an average clutch size of 4.9 eggs. Production were estimated at 22%. Average tail feather length for 65 geese was reported at 153mm (N=15) for adults and 136mm (N=50) for immatures. [BHC]

122. _____. 1975. Report of survey-inventory activities, waterfowl. Vol. VI. Alaska Dept. Fish and Game. Fed. Aid Wildl. Rest. Prog. Rep. Proj. W-17-7, Jobs 11.0, 11.1, 11.2, 11.3 and 22. Juneau. 53pp.

Summary of information collected on the nesting grounds in 1974. Average clutch size (sample size not reported) was 5.6 eggs. Nest success was not reported but production was estimated at 35% young. [BHC]

123. _____, and R. G. Bromley. 1976. Driving Canada geese by helicopter. Wildl. Soc. Bull. 4:180-181.

Describes use of helicopters to capture flocks of flightless geese and compares costs to other methods of capturing molting geese. [BHC]

124. _____. 1976. Report of survey and inventory activities - Waterfowl. Vol. VII. Alaska Dept. Fish and Game. Fed. Aid Wildl. Rest. Prog. Rep. Proj. W-17-8, Jobs 11.0, 11.1, 11.2, and 11.3. Juneau. 61pp.

Summary of information collected on the nesting grounds in 1975. Nest fates and average clutch size were not reported. A calculated 17.9% of the July population was composed of young geese. Maps depicting the distribution of nesting dusky geese on the west Copper River Delta in 1975 and 1976 are presented. [BHC]

125. _____. 1977. Report of survey-inventory activities. Vol. VIII. Waterfowl. Alaska Dept. Fish

DRAFT

and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-17-9, Job 11,0-11.3, and 22.0. Juneau. 37pp.

Summary of information collected on the nesting grounds in 1976. No nest success was reported but average clutch size (N=168) was 4.8 eggs. Twenty-four percent of the July population was composed of young. [BHC]

126. _____. 1978. Annual report of survey-inventory activities. Vol. IX. Waterfowl. Alaska Dept. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-17-10, Job 10.0. Juneau. 27pp.

Summary of information collected on the nesting grounds in 1977. No nest success reported but production reported to be "excellent". Clutch size for an unreported sample size was 5.4 eggs. Production was calculated to be 44.3%. Distribution of band returns from 1973-77 was reported. [BHC]

127. _____, and D. Sellers. 1979. Annual report of survey and inventory activities - Waterfowl. Vol. X. Alaska Dept. Fish and Game. Fed. Aid Wildl. Rest. Prog. Rep. Proj. W-17-11, Job 10. Juneau. 29pp.

Summary of information collected on the nesting grounds in 1978. No nesting data were reported. Production

DRAFT

was estimated to be 24.8%. Band recovery rates and distribution were reported. [BHC]

128. _____. 1980. Annual report of survey-inventory activities. Vol. XI. Waterfowl. Alaska Dept. Fish and Game. Fed. Aid in Wildl. Rest. Rep. Proj. W-19-1, Job 10.0. Juneau. 35pp.

Summary of information collected on the nesting grounds in 1979. Nest success (sample size not reported) was reported to be 7%. Nest losses were primarily the results of predation. A calculated 16% young were observed in the July population. Results of air-to-ground comparisons using photography tests preliminary to conducting a breeding grounds population survey were reported. [BHC]

129. _____. 1982. Annual report for survey-inventory activities. Vol. XII. Waterfowl. Alaska Dept. Fish and Game. Fed. Aid in Wildl. Rest. Prog. Rep. Proj. W-19-2, Job 11.0. Juneau. 48pp.

Summary of information collected on nesting grounds in 1980. While the final fate of 231 nests was not reported, midway through incubation 25% had been destroyed, 9% abandoned, and 65% still active. Nest predation was reported as "substantial". Clutch size

averaged 5.4 (N=152) eggs. A calculated 23.7% of the July population was composed of young birds. [BHC]

130. _____, R. G. Bromley, D. McKnight, and R. S. Rodgers. 1979. Pages 322-330 in R. L. Jarvis and J. C. Bartonek, eds. Management and biology of Pacific Flyway geese. OSU Book Store, Inc. Corvallis.

The management of dusky Canada geese (Branta canadensis occidentalis) has, in less than 30 years, evolved from guesswork based on little information to meaningful actions supported by extensive research findings and a continuum of population data. In this paper we trace the major events leading to present management, describe current management procedures and discuss challenges of the future. Innovative methods of population management must be developed to cope with a new and dynamic situation on the wintering grounds.
[Authors' abstract]

131. Trainer, C. E. 1959. The 1959 western Canada goose (Branta canadensis occidentalis) study on the Copper River Delta, Alaska. In Ann. waterfowl rep., Alaska. U.S Fish Wildl. Serv., Juneau. 9pp.

Identified dunegrass, herb, alder-willow, and alder-dunegrass as the four major cover types on the Copper

River Delta. A calculated 108 dusky goose nests occurred per square-mile with 97% located in mixed forb-low shrub habitat. Average clutch size was 5.6 eggs. Eighty-nine percent of the nests were successful with tidal flooding being the primary cause of nest failure. Only 8 of 1,162 eggs (0.7%) were identified as destroyed by predators, all avian. [BHC]

132. _____. 1967. Appraisal of Canada goose nesting densities on the Copper River Delta, Alaska. U. S. Fish and Wildl. Serv. Rep. Juneau. 9pp.

Based on estimates of suitable habitat, average number of young produced per nest on 1959 study area, and adjusted for varying density of nests, a calculated 12,781 young dusky geese were hatched on the Copper River Delta in 1959. [BHC]

133. Trauger, D. L., and J. C. Bartonek. 1977. Leech parasitism of waterfowl in North America. Wildfowl 28:143-152.

Reports that Robert G. Bromley removed leeches from under the nictitating membranes of three dusky Canada geese that were captured along with 500 other geese on Alaganik Slough in the Copper River Delta between 23

DRAFT

July and 2 August 1974. Another 40 females trapped on nests in early June were not infested. [JEC]

134. Weeden, R., P. LeRoux and B. Hilliker. 1969. Waterfowl Report. Vol. X. Alaska Dept. fish and Game. Fed Aid in Wildl. Rest. Prog. Rep. Proj. W-13-R-3 and W-17-1, Work Plan C. Juneau. 19pp.

Presents a table summarizing the age and sex of 433 geese banded in 1968. [BHC]

135. Yocom, C. F. 1963. July bird life in the Copper River Delta country, Alaska - 1962. The Murrelet 44:28-34.

Brief description of nesting habitat on the Copper River Delta. Mentions noticeable trails left in sedge-grass by flocks of molting geese in July. Presents weight and culmen and tarsus length for 5 molting adult females and 5 juveniles. [BHC]

DRAFT

SUBJECT INDEX

Age and Sex Ratios, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23,
25, 30, 31, 32, 53, 67, 68, 69, 71, 72,
78

Banding, Marking, Capture, 14, 16, 17, 18, 19, 21, 22, 33,
34, 55, 63, 64, 78, 79, 89, 91, 92, 105,
123, 127, 134

Behavior, 59, 60, 112, 113

Breeding Ecology, 7, 8, 37, 131

Depredation and Control, 26, 27, 59, 60

Distribution, 2, 3, 4, 5, 9, 10, 11, 12, 23, 25, 29, 33, 34,
38, 39, 40, 41, 42, 43, 44, 47, 51,
52, 57, 58, 62, 74, 75, 80, 81, 82, 83,
86, 87, 91, 93, 94, 97, 114, 115, 116,
117, 124, 127

Feeding, Foods, and Nutrition, 8, 59, 60

Genetics and Taxonomy, 2, 4, 5, 9, 12, 24, 41, 42, 43, 46,
76, 81, 87, 88, 90, 94, 97, 115, 116,
117

DRAFT

Harvest, Hunting Statistics, Hunting Mortality, 20, 23, 25,
30, 31, 32, 33, 34, 55, 63, 64, 65, 66,
67, 68, 69, 70, 71, 72, 112, 113

Habitat, 1, 7, 13, 15, 35, 36, 37, 54, 59, 60, 61, 77, 85,
89, 99, 100, 101, 103, 118, 131, 135

Historical, 3, 4, 5, 9, 10, 11, 12, 29, 42, 43, 44, 50, 62,
74, 78, 79, 83, 86, 87, 89, 91, 92, 93,
114

Impact Studies and Assessments, 1, 6, 58, 99, 100, 101, 107,
108

Management, 6, 7, 8, 13, 15, 20, 23, 25, 28, 30, 31, 32,
33, 34, 48, 49, 55, 56, 58, 59, 60, 63,
65, 66, 67, 68, 69, 70, 71, 72, 73, 77,
95, 96, 102, 118, 130

Migration, 8, 58, 61, 85

Mortality and Survival, 20, 23, 25, 29, 30, 31, 32, 33, 34,
53, 55, 63, 64, 71, 72, 112, 113

DRAFT

Nesting, Eggs, and Broods, 7, 8, 13, 14, 15, 16, 17, 18, 19,
20, 21, 22, 45, 48, 49, 53, 77, 78, 79,
84, 89, 91, 92, 98, 104, 106, 108, 109,
110, 111, 119, 120, 121, 122, 124, 125,
126, 127, 128, 129, 131, 135

Parasites, 133

Population Dynamics, 20, 23, 25, 63, 64

Population Estimates and Indices, 14, 15, 16, 17, 18, 19,
20, 21, 22, 23, 25, 30, 31, 32, 71, 72
105, 106, 107

Predation, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 33, 55,
65, 66, 67, 68, 69, 70, 71, 72, 73, 78,
79, 89, 91, 92, 104, 108, 109, 110, 129

Production, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 25, 33,
48, 49, 53, 54, 84, 89, 91, 92, 98, 104,
105, 107, 108, 109, 110, 111, 119, 120,
121, 122, 124, 125, 126, 127, 128, 129,
131, 132

Releases and Transplants, 20, 21, 22